USING INTEGRATION TO DERIVE GEOMETRIC FORMULAS

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We can use integration to derive various known geometric formulas.

Problem 1. Derive the formula for the circumference of a circle of radius r by computing the arclength of the curve $\sqrt{r^2 - x^2}$ from $x = -r$ to $x = r$.

Problem 2. Derive the formula for the area of a circle of radius r by computing the area between the curves $\sqrt{r^2 - x^2}$ and $-\sqrt{r^2 - x^2}$ between $x = -r$ and $x = r$.

Problem 3. Derive the formula for the volume of a sphere of radius r by computing the volume of "the object obtained by rotating the curve $\sqrt{r^2 - x^2}$ above the x-axis".

Problem 4. Derive the formula for the volume of a cone whose height is h and whose base has area A by "integrating along the height".